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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/695,959	10/27/2003	Matthew W. Miller	MI22-2400	8008
21567	7590	05/02/2006	EXAMINER	
WELLS ST. JOHN P.S. 601 W. FIRST AVENUE, SUITE 1300 SPOKANE, WA 99201			TRINH, HOA B	
			ART UNIT	PAPER NUMBER
			2814	

DATE MAILED: 05/02/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/695,959

Applicant(s)

MILLER ET AL.

Examiner

Vikki H. Trinh

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02 February 2006.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-42, 44-54 and 99-129 is/are pending in the application.
- 4a) Of the above claim(s) 99-129 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 27-31 and 52-54 is/are allowed.
- 6) ☒ Claim(s) 1-26, 32-42 and 44-51 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Acknowledgement

An amendment filed on 02/02/06 has been considered. Claims 1-42, 44-54, 99-129 are pending.

Election/Restrictions

1. Applicant's election without traverse of Species I, figures 1-3 in the reply filed on 08/17/05 is acknowledged.
2. Claims 99-129 are further withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected species. Note: claims 99-129 include a limitation of the canceled claim 55, a non-elected species, which recites the first electrode has an exposed surface that is being treated.
3. This application contains claims 99-129 drawn to an invention nonelected without traverse. A complete reply to the final rejection must include cancellation of nonelected claims or other appropriate action (37 CFR 1.144) See MPEP § 821.01.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.
5. Claims 1, 34, 99-103, 111, 119, 122, 129 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In the above claims, each include a phase "without depositing any material onto the exposed oxide-containing surface" or "being void of depositing any material onto the exposed

Art Unit: 2814

oxide-containing surface” is contradictory and unclear, because in the subsequent step following the phase applicants state that a second capacitor electrode formed over the treated oxide-containing surface.

In order to expedite the prosecution process of this patent application in this Office Action, the examiner treats the present claims as though they are recited without the phase above.

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1-4, 9-14, 19-25, 32-33 are rejected under 35 U.S.C. 102(e) as being anticipated by Merchant et al. (6,784,478) (hereinafter Merchant).

Merchant discloses, as to claim 1, a method of forming a capacitor 14 (fig. 1), comprising forming a first capacitor electrode 30 (fig. 1) over a semiconductor substrate 6 (fig. 1); forming a capacitor dielectric region 32 (fig. 1) onto the first capacitor electrode 30, the capacitor dielectric region 32 comprising an exposed oxide containing surface (col. 4, lines 35-45); treating the exposed oxide containing surface of the capacitor dielectric region with at least one of a silane (col. 4, lines 35-40); and depositing a second capacitor electrode 32 (fig. 1) over the treated oxide containing surface, the second capacitor electrode 32 comprising an inner metal surface contacting against the treated oxide containing surface. Note that Merchant teaches that the

Art Unit: 2814

dielectric layer is formed before the top electrode is laid thereon, thereby being exposed.

Merchant teaches that the dielectric layer is made of silane oxide which is an inherent result of silane doping of the oxide material.

As to claim 2, the first capacitor electrode consists essentially of semiconductive material (col. 1, col. 39).

As to claim 3, the first capacitor electrode consists essentially of metal (col. 1, lines 39-40, and col. 4, lines 31-45).

As to claims 4 and 14, the exposed oxide-containing surface comprises hafnium oxide (col. 4, lines 40-41) and has a thickness.

As to claim 9, the treating is with at least one silane (col. 4, lines 39-41).

As to claim 10, Merchant is silent about halogen, thereby the silane is used during the treating is implicitly void of halogen.

As to claim 11, the compound formula for silane is SiH_4 which falls within the selected options of the claim.

As to claim 19, the inner metal surface comprises an elemental metal (col. 1, lines 39-41).

As to claims 12-13, the treated layer 32 (fig. 1) has a thickness.

As to claim 20, the inner metal surface comprises tungsten (col. 1, lines 39-41).

As to claim 21, the inner metal surface comprises a conductive metal compound (col. 1, lines 39-41).

As to claim 22, the inner metal surface comprises TiN (col. 1, lines 39-41).

As to claim 23, the second capacitor consists essentially of metal (col. 1, lines 39-41).

As to claim 24, the effect of treating has an inherent result as claimed.

Art Unit: 2814

As to claim 25, the silane oxide of Merchant has an OH groups that inherently result in the treating effect as claimed because silane compound formula is SiH_4 and the combination of silane and the oxide containing surface would inherently include an OH group as claimed.

As to claim 32, the first capacitor consists of semiconductor material (col. 1, lines 38-39) and the second capacitor consists essentially of metal (col. 1, lines 40-41) thereby being forming an MIS capacitor. Note that the dielectric layer is an insulator layer.

As to claim 33, the first capacitor electrode consists essentially of metal (col. 4, lines 30-34) and the second capacitor electrode (col. 4, lines 30-45) consists essentially of metal forming an MIM capacitor. Note that the dielectric layer is an insulator layer.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

10. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various

Art Unit: 2814

claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

11. Claims 5, 15, and 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Merchant, as applied to claim 1 above, in view of Emesh et al. (5,452,178) (hereinafter Emesh).

Merchant discloses the invention substantially as claimed. However, Merchant does not explicitly teach specifically that the oxide-containing surface comprises aluminum oxide.

Emesh discloses an analogous method and device capacitor having a first electrode and a second electrode with a dielectric layer 60, 64, 66 (fig. 3) made of aluminum oxide (col. 9, lines 26-27) and sandwiched in between the electrodes, wherein the dielectric layer includes multi-layers 60, 64, 66, 70 (fig. 3).

Therefore, as to claims 5, 36, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Merchant with aluminum oxide, as taught by Emesh, so as to provide an alternative material for the dielectric layer.

In claim 15, the dielectric layer has a thickness dimension.

12. Claims 6-8, 37-39 are rejected under 35 U.S.C. 103(a) as being unpatentable over Merchant, as applied to claim 1 above, in view of Kudoh et al. (6,853,540) (hereinafter Kudoh).

Merchant discloses the invention substantially as claimed. However, Merchant does not explicitly teach that the treating is with at least one borane.

Art Unit: 2814

Kudoh discloses an analogous method and capacitor having borane coupling agent (col. 3, lines 25-30) added to the surface of the insulating layer (dielectric layer) of the capacitor device.

Therefore, as to claims 6, 37, it would have been obvious to one of ordinary skill in the time the invention was made to modify the invention of Merchant with the borane agent added to the surface of the dielectric layer, as taught by Kudoh, so as to prevent electrical breakdown (Kudoh, col. 3, lines 35-39).

As to claims 7, 38, Kudoh teaches the use of borane without mentioning halogen which is interpreted as being void of halogen.

As to claims 8, 39, generally the compound formula for borane in Merchant is BH_3 .

13. Claims 16-18, 34-35, 40-42, 44-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Merchant, as applied to claim 1 above, in view of Narwankar et al. (6,475,854) (hereinafter Narwankar).

Merchant discloses the invention substantially as claimed. However, Merchant does not explicitly teach that treating comprises a temperature range of 200-500 degree Celsius and a pressure range of 1-100 Torr.

Narwankar discloses an analogous method and capacitor having a first electrode, a second electrode, and a dielectric layer 606 (fig. 6f) sandwiched between the electrodes. The dielectric layer 606 is treated or annealed at a temperature of 350-550 degrees Celsius and a pressure of few Torr (2.5 Torr to 1 atm. (Table 1, col. 12). The temperature range and the pressure range overlap the claimed ranges.

Therefore, as to claim 16, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Merchant with the temperature and pressure ranges, as taught by Narwankar, so as to provide the parameter value for the treating.

As to claims 17 and 18, 34, 44, Narwankar teaches that the treating is for 2 minutes (col. 12, Table 1) so as to provide the duration for annealing which falls within the at least 1 second, or at least 10 seconds as claimed.

As to claim 35, Merchant teaches that the exposed oxide-containing surface comprises hafnium oxide (col. 4, lines 40-41) and has a thickness.

As to claim 40, Merchant discloses the treating is with at least one silane (col. 4, lines 39-41).

As to claim 41, Merchant is silent about halogen, thereby the silane is used during the treating is implicitly void of halogen.

As to claim 42, generally the compound formula for silane in Merchant is SiH_4 which falls within the selected options of the claim.

As to claim 45, Merchant teaches the inner metal surface comprises tungsten (col. 1, lines 39-41).

As to claim 46, Merchant teaches the inner metal surface comprises a conductive metal compound (col. 1, lines 39-41).

As to claim 47, Merchant teaches the inner metal surface comprises TiN (col. 1, lines 39-41).

As to claim 48, Merchant teaches the second capacitor consists essentially of metal (col. 1, lines 39-41).

Art Unit: 2814

As to claim 49, Merchant teaches the effect of treating has an inherent result as claimed.

As to claim 50, Merchant teaches the silane oxide of Merchant has an OH groups that inherently result in the treating effect as claimed because silane compound formula is SiH_4 and the combination of silane and the oxide containing surface would inherently include an OH group as claimed.

14. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Merchant, as applied to claim 1 above, in view of Nakamura et al. (6,605,530) (hereinafter Nakamura).

Merchant discloses the invention substantially as claimed. However, Merchant does not explicitly teach that the second electrode comprises a halogen containing gas. Note that the effect of treating with silane is the same as claimed.

Nakamura discloses an analogous method and capacitor having a first electrode 101, a dielectric layer 102, and a second electrode 103 (fig. 47), wherein the second electrode 103 comprises a halogen containing gas (col. 18, lines 14-15).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Merchant with the halogen containing gas, as taught by Nakamura, so as to provide the halogen-containing second electrode.

15. Claim 51 is rejected under 35 U.S.C. 103(a) as being unpatentable over Merchant, in view of Narwankar et al. (6,475,854) (hereinafter Narwankar), as applied to claim 34, and further in view of Nakamura.

Merchant, in view of Narwankar, discloses the invention substantially as claimed. However, Merchant, in view of Narwankar, does not explicitly teach that the second electrode

Art Unit: 2814

comprises a halogen containing gas. Note that the effect of treating with silane is the same as claimed.

Nakamura discloses an analogous method and capacitor having a first electrode 101, a dielectric layer 102, and a second electrode 103 (fig. 47), wherein the second electrode 103 comprises a halogen containing gas (col. 18, lines 14-15).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the invention of Merchant, in view of Narwankar, with the halogen containing gas, as taught by Nakamura, so as to provide the halogen-containing second electrode.

Allowable Subject Matter

16. Claims 27-31 and 52-54 are allowed.

17. The following is a statement of reasons for the indication of allowable subject matter:

The prior art of record does not disclose or fairly suggest either in singly or in combination a method of forming a capacitor having a step of depositing multiple dielectric layers and intermediate at least some of the dielectric layer depositions, treating an outer surface of the dielectric region being formed with at least one of the borane or silane, and other steps in the claims.

Response to Arguments

18. Applicant's arguments filed 02/02/06 have been fully considered but they are not persuasive.

In the remarks, applicants argue the rejection of claim 1 under 35 USC 102e as being anticipated by Merchant et al. In particular, applicants argue that Merchant et al. does not

disclose the newly amended claim 1 which includes the treating step without depositing any material onto the exposed oxide-containing surface. However, as stated in the above rejection, the newly amended claim 1 includes the new treating step limitation which renders indefiniteness, because the second capacitor is formed over the treated exposed oxide-containing surface. Similar reasons are applied to applicants' same arguments as that of claim 1 for claims 34, 99-129.

For the foregoing reason, the rejections are maintained.

Conclusion

19. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

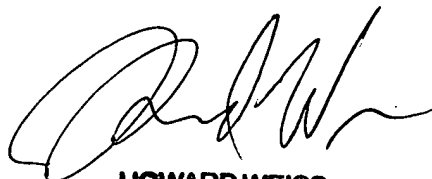
Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Vikki Trinh whose telephone number is (571) 272-1719. The Examiner can normally be reached from Monday-Friday, 9:00 AM - 5:30 PM Eastern Time. If

attempts to reach the examiner by telephone are unsuccessful, the Examiner's supervisor, Mr. Wael Fahmy, can be reached at (571) 272-1705. The office fax number is 703-872-9306.

Any request for information regarding to the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Also, status information for published applications may be obtained from either Private PAIR or Public Pair. In addition, status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. If you have questions pertaining to the Private PAIR system, please contact the Electronic Business Center (EBC) at 866-217-9197 (toll free).

Lastly, paper copies of cited U.S. patents and U.S. patent application publications will cease to be mailed to applicants with Office actions as of June 2004. Paper copies of foreign patents and non-patent literature will continue to be included with office actions. These cited U.S. patents and patent application publications are available for download via the Office's PAIR. As an alternate source, all U.S. patents and patent application publications are available on the USPTO web site (www.uspto.gov), from the Office of Public Records and from commercial sources. Applicants are referred to the Electronic Business Center (EBC) at <http://www.uspto.gov/ebc/index.html> or 1-866-217-9197 for information on this policy. Requests to restart a period for response due to a missing U.S. patent or patent application publications will not be granted.

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HOWARD WEISS
PRIMARY EXAMINER